CLAIMS

We claim:

1. A computer implemented method for predicting failure in a system, comprising:

measuring data associated with a system;

creating a prediction of a failure of said system using a probabilistic model and said data; and

communicating said prediction.

2. The method of claim 1 wherein said measuring further comprises receiving system information from said system.

3. The method of claim 1, wherein said creating further comprises creating a prediction of a failure of a component of said system.

4. The method of claim 1, wherein said creating further comprises creating a prediction of a failure of multiple systems based on said prediction.

5. The method of claim 1 wherein said measuring, creating, and communicating steps are performed on said system.

6. The method of claim 1 further comprising comparing said prediction to criteria. .

7. The method of claim 1 wherein at least one of said creating and communicating steps occurs at a remote location.

8. The method of claim 1 wherein said probabilistic model comprises multiple models.

9. The method of claim 1 further comprising ranking variables in said probabilistic model according to said variable's contribution to said prediction.

10. The method of claim 1 applied to predict failure in a material's microstructure.

11. The method of claim 1 wherein said data comprises referenced data, sensed data, and inferred data and wherein said method further comprises relating said reference data to a first set of variables, relating said sensed data to a second set of variables, and inferring a third set of variables from said sensed data.

12. The method of claim 1 further comprising sending said data to a remote location and wherein said creating occurs at said remote location.

13. The method of claim 12 further comprising receiving said prediction from said remote location.

14. The method of claim 1 further comprising developing said probabilistic model prior to said creating.

15. The method of claim 14 wherein said developing further comprises:

identifying at least one failure mechanism of a component of said system from said component's characteristics selected from a group comprising: material properties, environmental conditions, design characteristics, component loading, and component usage;

identifying significant random variables of said at least one failure mechanism;

identifying statistical parameters of said significant random variables; and

formulating a strategy for probabilistic analysis.

16. The method of claim 15 wherein said data comprises referenced data, sensed data, and inferred data and wherein said developing step further comprises determining which of said significant random variables are related to said referenced data, which of said significant random variables are related to said sensed data, and which of said significant random variables are inferred from said sensed data.

17. The method of claim 12 wherein said developing further comprises setting criteria for communicating said prediction.

18. The method of claim 1, wherein said probabilistic model utilizes fast probability methods.

19. The method of claim 18, wherein said fast probability methods are selected from a group including direct: First Order Reliability Methods, Second Order Reliability Methods, Advanced Mean Value methods, and Mean Value methods.

20. The method of claim 18, wherein said fast probability methods are selected from a group including response surface: First Order Reliability Methods, Second Order Reliability Methods, Advanced Mean Value methods, and Mean Value methods.

21. The method of claim 1, wherein said probabilistic model utilizes simulation techniques.

22. The method of claim 21, wherein said simulation techniques are direct methods selected from a group including: Monte Carlo methods and importance sampling methods.

23. The method of claim 21, wherein said simulation techniques are response surface methods selected from a group including: Monte Carlo methods and importance sampling methods.

24. The method of claim 15, wherein at least one said failure mechanism is described by an equation and said equation is divided into a capacity section and a demand section.

25. An apparatus for predicting failure of a system, said apparatus comprising:
sensors for acquiring data from a system;
a first computer comprising:
a processor;

a memory containing:

instructions for measuring said data;

instructions for creating a prediction of a failure of said system using a probabilistic model and said data; and

instructions for communicating said prediction; and

a communication device for communicating said prediction.

26. The apparatus of claim 25 wherein said instructions for creating further comprise instructions for predicting failure of at least one component of said system.

27. The apparatus of claim 25 wherein said instructions for measuring further comprise instructions for receiving system information from said system.

28. The apparatus of claim 27 further comprising a second computer, said second computer comprising:

a processor; and

a memory, said memory containing:

instructions for measuring said data;

instructions for storing said data;

instructions for sending said data to said first computer as said system information.

29. The apparatus of claim 25 further comprising:

a second computer, said second computer comprising:

a processor; and

a memory, said memory containing:

instructions for receiving said prediction; and

instructions for communicating said prediction; and

a second communication device for communicating said prediction.

30. The apparatus of claim 25 wherein said communication device further comprises a warning signal.

31. The apparatus of claim 25, said apparatus further comprising a sending device for sending said data to a remote location.

32. The apparatus of claim 31, wherein said first computer is located at said remote location.

33. The apparatus of claim 25 further comprising instructions for comparing said prediction to criteria.

34. The apparatus of claim 25 wherein said probabilistic model comprises multiple models.

35. The apparatus of claim 25 wherein said probabilistic model comprises variables ranked according to said variables' contribution to said prediction.

36. The apparatus of claim 25 applied to predict failure in a material's microstructure.

37. The apparatus of claim 25 wherein said data comprises referenced data, sensed data, and inferred data and wherein said apparatus further comprises instructions for: relating said reference data to a first set of variables; relating said sensed data to a second set of variables; and inferring a third set of variables from said sensed data.

38. The apparatus of claim 25, wherein said probabilistic model utilizes fast probability methods.

39. The apparatus of claim 38, wherein said fast probability methods are selected from a group including direct: First Order Reliability Methods, Second Order Reliability Methods, Advanced Mean Value methods, and Mean Value methods.

40. The apparatus of claim 38, wherein said fast probability methods are selected from a group including response surface: First Order Reliability Methods, Second Order Reliability Methods, Advanced Mean Value methods, and Mean Value methods.

41. The apparatus of claim 25, wherein said probabilistic model utilizes simulation techniques.

42. The apparatus of claim 41, wherein said simulation techniques are direct methods selected from a group including: Monte Carlo methods, and importance sampling methods.

43. The apparatus of claim 41, wherein said simulation techniques are response surface methods selected from a group including: Monte Carlo methods, and importance sampling methods.

44. The apparatus of claim 25 wherein said instructions for creating further comprise instructions for creating a prediction of a failure of multiple systems based on said prediction.

45. The apparatus of claim 25, said probabilistic model comprising at least one failure mechanism of a component of said system.

46. The apparatus of claim 25, wherein said at least one failure mechanism relates to a material microstructure.

47. The apparatus of claim 25, wherein said at least one failure mechanism is described by an equation and said equation is divided into a capacity section and a demand section.

48. A computer program product for predicting failure of a system for use in conjunction with a computer system, said computer program product comprising a computer readable storage medium and a computer program mechanism embedded therein, said computer program mechanism containing:

instructions for measuring data;

instructions for storing said data;

instructions for creating a prediction of failure of said system using a probabilistic model and said data; and

instructions for communicating said prediction.

49. The computer program product of claim 48 wherein said instructions for measuring data further comprise instructions for receiving system information from said system.

50. The computer program product of claim 48 wherein said instructions for creating further comprise instructions for creating a prediction of a failure of at least one component of said system.

51. The computer program product of claim 48 wherein said instructions for creating further comprise instructions for creating a prediction of a failure of multiple systems based on said prediction.

52. The computer program product of claim 48, said model comprising at least one failure mechanism of a component of said system.

53. The computer program product of claim 48, wherein said at least one failure mechanism relates to a material microstructure.

54. The computer program product of claim 48, wherein said at least one failure mechanism is described by an equation and said equation is divided into a capacity section and a demand section.

55. The computer program product of claim 48 further comprising instructions for comparing said prediction to criteria.

56. The computer program product of claim 48 wherein said probabilistic model comprises multiple models.

57. The computer program product of claim 48 further comprising ranking variables in said probabilistic model according to said variables' contribution to said prediction.

58. The computer program product of claim 48 applied to predict failure in a material's microstructure.

59. The computer program product of claim 48 wherein said data comprises referenced data, sensed data, and inferred data and wherein said apparatus further comprises instructions for: relating said reference data to a first set of variables; relating said sensed data to a second set of variables; and inferring a third set of variables from said sensed data.

60. The computer program product of claim 48, wherein said probabilistic model utilizes fast probability methods.

61. The computer program product of claim 60, wherein said fast probability methods are selected from a group including direct: First Order Reliability Methods, Second Order Reliability Methods, Advanced Mean Value methods, and Mean Value methods.

62. The computer program product of claim 60, wherein said fast probability methods are selected from a group including response surface: First Order Reliability Methods, Second Order Reliability Methods, Advanced Mean Value methods, and Mean Value methods.

63. The computer program product of claim 48, wherein said probabilistic model utilizes simulation techniques.

64. The computer program product of claim 63, wherein said simulation techniques are direct methods selected from a group including: Monte Carlo methods, and importance sampling methods.

65. The computer program product of claim 63, wherein said simulation techniques are response surface methods selected from a group including: Monte Carlo methods, and importance sampling methods.

66. The computer program product of claim 49 further comprising a second computer program product, said second computer program product comprising a second computer readable storage medium and a second computer program mechanism embedded therein, said second computer program mechanism containing:

instructions for measuring said data;

instructions for storing said data; and

instructions for sending said data to said first computer as said system information.

67. The computer program product of claim 48 further comprising a second computer program product, said second computer program product comprising a second computer readable storage medium and a second computer program mechanism embedded therein, said second computer program mechanism containing:

instructions for receiving said prediction; and

instructions for communicating said prediction.